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ABSTRACT

Perception and effects of foreign language publications in engineering research are examined. Through the use of both survey and archival sources, including coverage in major scientific and technical databases as vended by DIALOG, various aspects of the foreign language barrier were measured. A foreign language barrier is said to exist when important work is being published in a language the potential users cannot easily decode or have decoded for them. It is concluded that there is little concern about this subject among respondents, but that a significant amount of foreign language research is being ignored. The survey instrument is appended, as well as data in ranked order by database. Contains 12 references. (Author/LB)

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Is There a Foreign Language Barrier in Engineering Research?

The University Of Michigan
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Fall 1990

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Carla Hawks; Jim Ottaviani; Fritz Whitcomb

Is There a Foreign Language Barrier in Engineering Research?

ABSTRACT

This paper is an attempt to ascertain perception and effects of foreign language publications in engineering research. Through the use of both survey and archival sources, we measured various aspects of the foreign language barrier. It appears that there is little concern about this subject among respondents, but that a significant amount of foreign language research is being ignored.

THE PROBLEM

Difficulty in engineering communication is not a new concern. A case could be made that engineers are responsible for the construction of the language barrier that has created problems for themselves and others since. As the only thing completed at Babel, the language barrier has lasted longer than any physical wall they might have otherwise built.

Research focussing on the information needs and use of engineers with respect to foreign language materials is rare. Wood, and later Hutchins et al., included but did not focus on engineers in their research [Wood, 1967; Hutchins, 1971]. Both found a language barrier. J.A. Large, in his book "The Foreign Language Barrier", could quote only the Wood and Hutchins studies [Large, 1983]. It is unlikely that the language barrier went away between 1971 and 1983, nor is it likely that it has decreased between 1983 and today. With the increased industrialization of virtually every country in the world and disappearance of a language requirement in engineering schools it seems all the more improbable. Is language unimportant? As we will see, there is a perception by engineers that they are missing some important material because it is not published in English. The accuracy of their perception is not easy to determine, but some quantification of foreign language material availability is possible.

Frequently industry[1] driven [see Garvey, 1979], engineering research is not so much interested in adding increments to the knowledge base but addressing industry's and society's needs. Work going on elsewhere, be it in the home country or not, can be vitally important with respect to the patentability or marketability of a product. Language is only one of many barriers that delay or block the flow of information in the research environment [see Haag, 1984]. G.K.L. Chan gives an example of multiple barriers in the medical field [Chan, 1977]. While many barriers are measurable, such as publishing delays and bad search strategies, others are not. The impact of 'inferior

[1] Read: profit, in turn read:timeliness.

quality' publications and proprietary/copyright issues are difficult to quantify, as is the foreign language barrier. Chan points out that the major unknown is not the existence of a language barrier but the importance of it [Chan, 1976]. If foreign language publications are not important or are considered unimportant by those who might use them, there is in effect no language barrier. The basic question to ask is: Do engineers feel there is important work being published in other languages that they don't know about because it doesn't appear in English?

We assume there is – a significant amount of the engineering research is done in the U.S., but not all. For instance, roughly 10,000 scientific and technical journals are published in Japan, a vast majority of which are written only in Japanese [Sun, 1987]. We further assume that the problem does not lie solely in the negligence of the researchers themselves. The concept What You See Is What You Get is even more significant in this context than in desk-top publishing[2] , since access and desire for material assume exposure and some level of availability. We investigate the availability of foreign language material through standard bibliographic tools available to engineers. The aim is to understand engineers' bibliographic habits and explain why engineers cite the literature they do.

The purpose of the research is to raise awareness of the existence of foreign language materials and their importance to engineering research. Focussing on the University of Michigan makes this a case study of sorts, but the perceptions and problems encountered here are likely to be typical of those encountered elsewhere. The results of this research may suggest the next steps to be taken in raising awareness of the foreign language barrier. Upon completion, a logical step would be to administer the survey to a non-U.S. research institution, substituting the host country's native language for "English". A comparison of the U.S. and foreign responses could be followed by research on how publications are chosen for translation – by whom, with what delay, etc... It is hoped that some agitation will result from this research – either towards improving or abolishing translation services, language training, selection criteria, and awareness.

A foreign language barrier exists when important work is being published in languages the potential users cannot easily decode or have decoded for them. By easy decoding, we mean comprehension on par with a native speaker or that can be accomplished with infrequent use of a dictionary. Journal articles are the main published works considered here. Technical reports, though perhaps more important in engineering than in most other technical disciplines, were not specifically

[2] If such a thing can be imagined...

addressed[3], but they are included in this study. The engineering research surveyed here is limited to research done by University of Michigan faculty and students. An attempt was made to sample from all disciplines, both traditional (those in existence before World War II, e.g. civil and structural engineering) and recent (those arriving with or after the advent of "big science,"[4] e.g. nuclear and computer engineering).

LITERATURE REVIEW

A number of previous studies have addressed the problem foreign languages pose to the research community. Wood investigated the foreign language material use of university and industry researchers from organizations on the National Lending Library's approved borrowing list in a broad range of disciplines, including engineering [Wood, 1967]. Hutchins, et al. studied the academic community at the University of Sheffield [Hutchins, 1971]. Again, this study included but was not limited to engineers. Both studies concluded that foreign language materials were under-utilized, and made recommendations to address the problem. Subsequent studies with more limited scopes [Gordon, 1981; Thorp, 1988] have confirmed this under-utilization. These studies, in addition to not being particularly current, consider neither the U.S., where a large amount of research is being done, nor engineers, who do a significant amount of that research.

METHODOLOGY

Beyond measuring perception with a survey (see Appendix A for an annotated copy), measures of foreign language availability and use were also taken. The method of distribution was accidental sampling of Engineering Library users. Availability of foreign language materials was measured by coverage in major scientific and technical databases as vended by DIALOG. A list of the databases investigated and results of this investigation is presented in Appendix B. "Use" was measured via citation analysis. Major journals in each of the engineering fields in which research is done at the U. of M. were studied, and citations to foreign language journal articles were compared to total citations. Journals were chosen from recommendations by the Engineering Library Reference Staff, using the most recent copies available in the North Engineering Library and using the latest edition of *Ulrich's International Serials Directory* as the determinant of the language of the journal (see Appendix C).

[3] The difficulties in learning of the existence of appropriate reports, not to mention acquiring them, rival if not surpass language barriers [see, for instance, McClure, 1988; Garvey, 1987; Chakrabarti, 1983].

[4] Typified by massive government support and large collaborative efforts.

ANALYTIC METHODS AND PROCEDURES

The results of the survey were tallied (see Appendix A). A χ^2 significance test was run to determine the effect of placement of the question addressing perception of the language barrier: "Do you feel that there is important work being published in other languages ...".

DIALOG databases were searched using the same search strategy for each database. The "expand" command was used to determine which languages were included in each database, and with what frequency (see Appendix B). The results within each database have been ranked in two ways: including all languages besides English, and excluding languages other than French, German, Spanish, Italian, Russian, and Japanese.

Percentages were taken for each journal examined in the citation analysis (see Appendix C), and were combined for subsequent analysis. The non-English languages utilized were then ranked by frequency.

Spearman's correlations (ρ) were run between what languages survey respondents can read and what languages are cited in the literature. Another correlation test was run between what languages are cited and what languages are available in DIALOG databases. Finally, a correlation test was done between what languages are available in DIALOG databases and where survey respondents feel important research is being done.

FINDINGS

The results of the survey are summarized in Appendix A. Of the 35 usable responses, 18 felt there was no important work being published in other languages besides English. As will be discussed below, the placement of the question did not make a significant difference as to how it was answered.

Figure 1 shows the number of foreign language records retrieved from the DIALOG databases. Figure 2 presents these data in percentage form. It is important to realize that non-English records make up 21% of the total retrieved.

Figure 1

Number of DIALOG records retrieved

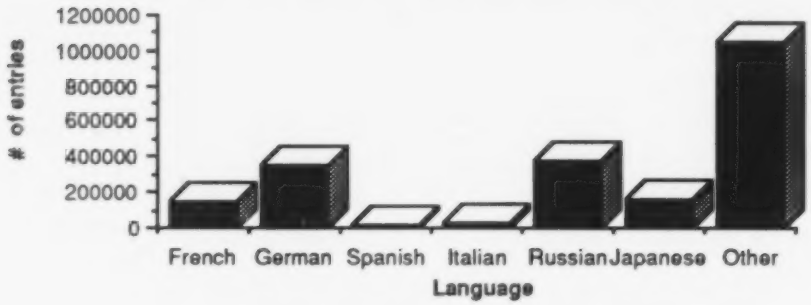


Figure 2

Percentage of DIALOG records retrieved

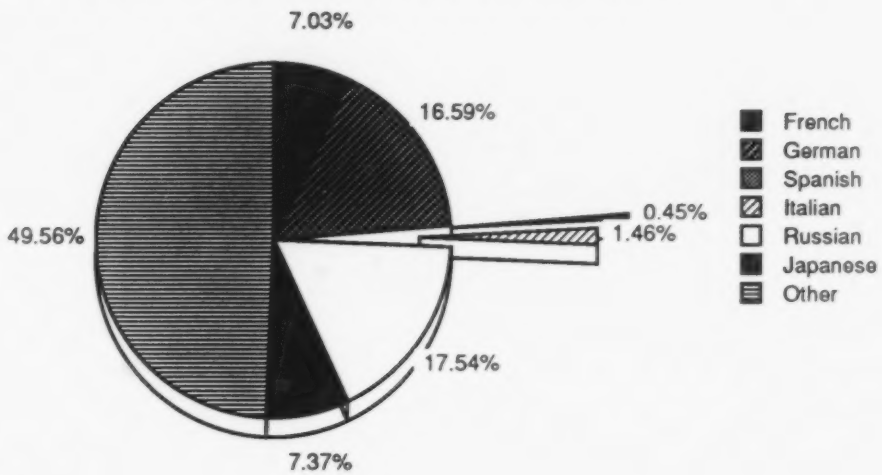


Figure 3 shows the number of citations in foreign languages from the citation analysis. Figure 4 presents these data in percentages. Non-English citations were 2.4% of the total analyzed.

Figure 3
Number of citations in each language

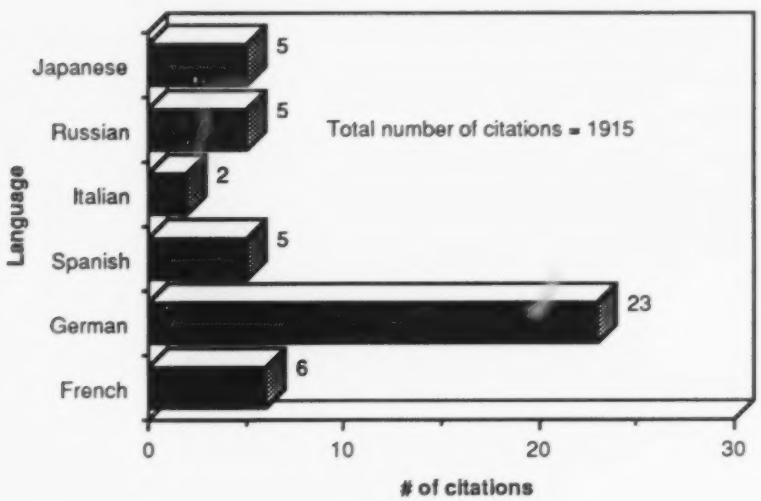
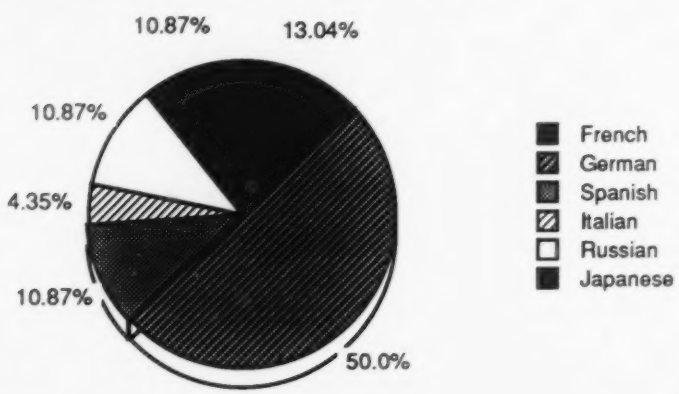


Figure 4
Percent of citations in each language



The following tables present the analysis of these data.

Table 1 shows data used to determine if there is a significant difference in responses to the survey question "Do you feel that there is important work being published in other languages that you don't know about because it doesn't appear in English?" depending on question placement. First refers to the question being the very first question on the survey. Last refers to the question being placed near the end of the survey.

Table 1
Correlation Table for Question Position

	First	Last	Total
Yes	15	4	19
No	8	8	16
Total	23	12	35

For this data, with one degree of freedom, χ^2 equals 3.2, indicating that placement did not have a significant effect on the responses at the 0.050 level.

Table 2 is a comparison of the how languages were ranked by frequency of citation in engineering journals surveyed and by the survey respondents' reported reading ability (rated poor or above).

Table 2
Comparison of Languages Between Journal Citations and Reading Ability

	Citation	Survey
French	2	1
German	1	2.5
Spanish	4	4
Italian	6	7
Russian	4	5
Japanese	4	6
Other	7	2.5

The resulting Spearman's correlation is weak: $\rho = 0.47$.

Table 3 compares how languages were ranked by frequency of citation in engineering journals surveyed and by the ranking of the languages covered in the DIALOG databases.

Table 3
Comparison of Languages Between Journal Citations and Coverage in DIALOG

	Citations	Total DIALOG
French	2	4
German	1	2
Spanish	4	6
Italian	6	5
Russian	4	1
Japanese	4	3

The correlation was weak, since $\rho = 0.43$. However, individual databases showing much higher correlations (greater than 0.7); *Chemical Engineering Abstracts, Pollution Abstracts, NTIS,* and *Compendex* may cover literature more appropriate for engineers than do *Inspec, Metadex, Ismec* and *Engineering Materials Abstracts*, which all showed correlations much below 0.7.

Table 4 compares the ranking of the languages used in the DIALOG databases and the survey respondents' ranking of "[w]here...important research [is] being done in your field besides the U.S.."

Table 4
Comparison of Languages Between Coverage in DIALOG and Survey Response to Where Important Research is Being Done

	Total DIALOG	Survey Rankings
French	4	3
German	2	2
Spanish	6	5
Italian	6	5
Russian	1	4
Japanese	3	1

These rankings are strongly correlated, with $\rho = 0.77$.

Weaknesses of the techniques and methods used in this test study are numerous. Among them are:

Perception

•The sample was not random, representative, or large. Only library visitors, including (predominantly) undergraduates, were surveyed. At this stage, the survey itself was being tested, and gives more information on the clarity of the survey questions than it does on the language barrier. Overall, the survey appears to measure what it set out to measure.

•Whether perception is reality will remain a question for philosophers. There is no way to ascertain the importance of foreign language materials - that there are thousands of articles published in English does not imply that articles written in English are important. Nor does the fact that there are only hundreds published in Hebrew imply that articles written in Hebrew are unimportant.

Availability

•Information obtained from DIALOG does not represent the only source of information used in engineering research - a future question should address sources of citations used.

•No attempt was made to determine what percent of all information published is covered in the database - only raw numbers were compared.

Use

•No attempt was made to compare the perceptions of use by U. of M. researchers with actual use. The citation analysis should focus on publications by U. of M. faculty, staff, and students and their cited references.

•The articles U. of M. researchers cite should be analyzed to determine whether their memories' of who they cited is accurate.

•Journals for the citation analysis were not chosen by the researchers. Although this may not be a large problem, any future work should focus some attention on the journals felt to be important.

•Self-citations may inflate rankings of language use, but were not accounted for in this study.

CONCLUSION

•There appears to be no strong perception that a language barrier exists, since the survey responses were evenly divided. The survey comments did not indicate any strong feelings on the respondents' parts. The respondents tend to ignore what is available. The DIALOG databases searched contained 21% non-English records, while only 2.4% of the citations from journals were non-English.

•There is no significant effect of the placement of the question "Do you feel that

there is important work being published in other languages..." on the response. Further, if there were any significant difference, it occurred opposite to what we expected. Those who, presumably, saw the question before any others were more likely to think that there was a language barrier. Could it be that the more they thought about the barrier, the less they were worried about it?

•There was poor correlation between respondents' reading ability in a given language and languages cited in journals. Italian, Russian and Japanese, while cited relatively often in the literature, are not often read by survey respondents. The important languages for engineering may be changing.

•Overall, database coverage and citation frequency do not appear to be correlated. We believe this to be misleading. The databases fell naturally into two groups, those with very low correlations and those with very high correlations. It appears that smaller databases show lower correlations, and may have relatively low importance in engineering research.

•Respondents' ranking of countries doing important research correlates strongly with the ranking of those countries' languages represented in the DIALOG databases. This might mean a number of things. DIALOG may base their decision of what languages to cover on what people feel are important. People may feel that a language is important because DIALOG covers it. Any number of other explanations (coincidence?) may be postulated.

Future research should include:

<u>Perception</u>

•Some measure of searching method – How citations are found (e.g. printed abstracting and indexing sources, online, via colleagues...) has a direct impact on exposure to and use of foreign language materials. Tied to this is search sophistication in e.g. DIALOG. Use of a language limiter online can give some indication of awareness of the foreign language barrier.

•Accounting for the fact that engineers are not homogeneous – Different types have differing information needs. Perhaps "big science" research uses different types of information than more traditional research fields. Perceptions about information availability may differ between these groups. The two groups should be analyzed separately.

•How perception differ at other universities, in other countries, and in industry?

<u>Availability</u>

•Determining coverage in printed abstracting, indexing, and online sources, a barrier imposed on the researcher from without – The language coverage (e.g. of 8,000 articles published in Hungarian, 5,000 are covered) percentages can be compared with perceptions of what researchers feel they are missing.

•Comparing this coverage with English coverage in foreign language databases – This is a measure of the barrier U.S. researchers meet relative to foreign

researchers.

•How availability differs at other universities, in other countries, and in industry?

Use

•Comparisons of actual citations in U. of M. researchers' publications with recollections from the survey for verification.

•Having articles appearing in journals identified as important by respondents citations analyzed to determine their foreign language citation frequency.

•How does use differ at other universities, in other countries, and in industry?

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Appendix A

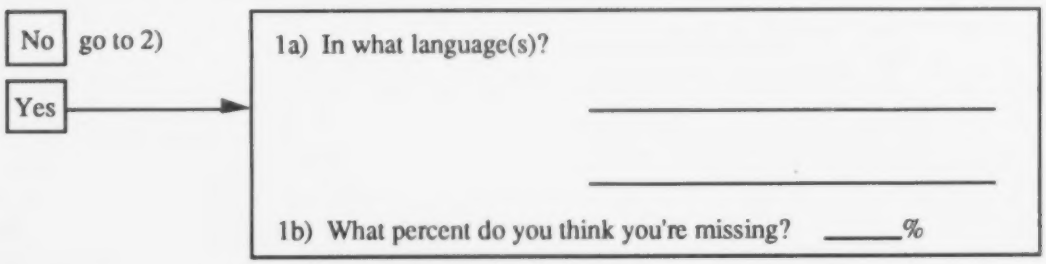
Survey with cumulated totals

The following is one version of the survey with responses summarized after each question. The other version of the survey placed this version's question 1) just before question 9), with questions 2) through 8) shifting up one place.

36 people responded to the survey. Of these, 35 were usable.

The following are a few (10) questions about information needs and foreign language publications in engineering research. Please fill out both sides.

1) Do you feel that there is important work being published in other languages that you don't know about because it doesn't appear in English?



18 people checked 'No' to this question. Of the 17 who checked 'Yes', the languages and percentage missed identified were:

French	**(5-50%)**
German	**(1-60%)**
Japanese	**(1-30%)**
Russian	**(15-100%)**
Chinese	**(5-50%)**

There was no significant difference in response depending on where the question was encountered in the survey.

2) Assess your reading ability in:

	Native	Excellent (infrequent use of a dictionary)	Fair (use of a dictionary once/paragraph)	Poor (barely possible, but I've done it)	None
English	22	10	3		
French			5	7	19
German		1	4	4	19
Japanese				2	22
Russian				3	27
other(s):	7		4	8	13

The "other" languages identified were Hebrew, Chinese, Spanish, Igbo, Persian, Korean, Arabic, Vietnamese, and Latin.

3) What do you consider to be the leading English language journal in your field?

What do you consider to be the leading **non**-English language journal in your field?

Responses to this item varied widely. In a future study, these responses would provide the names of journals upon which the citation analysis should be performed.

4) How many times did **you cite** non-English language journal articles in the last two papers you **wrote**? ☐ 0 ☐ 1-3 ☐ 4+ ☐ not applicable

0 = 22
1-3 = 4
4+ = 0
not applicable = 9

For the most part, people do not appear to be citing foreign language publications.

5) How many non-English journal articles were **cited** in the last two journal articles you **read**? ☐ 0 ☐ 1-3 ☐ 4+ ☐ don't remember

0 = 12
1 -3 = 8
4+ = 1
don't remember = 13

Again, for the most part people don't appear to be seeing foreign language citations.

6) Where is important research being done in your field besides the U.S.?

☐ No important research is being done elsewhere

Countries identified were Japan (18); Germany (11); England (6); France (5); USSR (4); None (2); and China, Belgium, Finland, Sweden,

Netherlands, Israel, Italy, and Norway (1).

7) When you encounter an article written in a foreign language, what do you do?
(Check all that apply):

- ☐ look for a summary or an abstract **13**
- ☐ attempt to translate it yourself **8**
- ☐ get help from a colleague **5**
- ☐ get help from a librarian **2**
- ☐ find a translation **15**
- ☐ ignore it **19**
- ☐ other _____ **2 e.g. GIVE UP**

It is interesting (and disconcerting) to note that "ignore it" was the most frequent response and "ask a librarian" was the least frequent – tied with "give up"

8) Are you aware of the Translations Indexes in the engineering library?

☐ No go to 9)

☐ Yes → 8a) Do you use them? ☐ Yes ☐ No

32 respondents checked 'No', the other 3 did not answer.

9) What other concerns do you have with regards to non-English language publications (or this questionnaire)?

_____

_____

_____

Some of the interesting responses to this question were:
•"If I'm MIRLYNing and find a foreign reference, I ignore it."
•"If translations are available for recent articles that would be good."
•"I occasionally run across articles in a foreign language, but I usually just ignore them. I guess I never really understood why you carried them."
•"It would be interesting to see if they provide us with as much info. as we give them." (respondent's emphasis)

10) Please check one:

☐ Faculty ☐ Graduate Student ☐ Undergraduate

Department: _____Engineering

Thanks for your help.

12 graduate students, 21 undergraduate students, and one visiting engineer responded to the survey. No attempt was made to break this small sample down by discipline.

The surveys were handed out as one double-sided sheet of paper, and were with very few exceptions filled out correctly.

Appendix B

DIALOG Database Data
(Ranked order by database)

The following data represent the ranked order given to the foreign language records retrieved in the selected DIALOG databases. A rank of "1" means the greatest number of records were in that language in that database (English and foreign languages other than the six used for this comparison excluded.). The DIALOG rankings were then compared to the citation analysis rankings of the languages cited most by researchers in the literature. The Spearman's correlation is denoted "ρ."

	Citation Analysis Ranking	Pollution Abstracts
French	3	1
German	1	2
Spanish	4	6
Italian	6	5
Russian	2	3
Japanese	5	4
		ρ =0.77

	Engineering Materials Abs.	ISMEC
French	4	3
German	2	2
Spanish	5	6
Italian	6	5
Russian	1	4
Japanese	3	1
	ρ =0.29	ρ =0.54

	METADEX	NTIS
French	4	2
German	2	1
Spanish	6	5
Italian	5	6
Russian	1	3
Japanese	3	4
	ρ =0.43	ρ =0.94

	COMPENDEX	INSPEC
French	3	3
German	1	2
Spanish	6	6
Italian	5	5
Russian	2	1
Japanese	4	4
	ρ =0.71	ρ =0.51

	Chemical Engineering Abs.	Total DIALOG Record Ranking by language
French	3	4
German	1	2
Spanish	4	6
Italian	6	5
Russian	2	1
Japanese	5	3
	ρ =0.83	ρ =0.43

The following is the division of records by language included in the selected DIALOG databases.

Language	Number of records for the Combined DIALOG databases	
French	149,161	
German	351,995	
Spanish	9,551	
Italian	30,947	
Russian	372,008	
Japanese	156,343	
Other (non-English)	1,051,503	
TOTAL NON-ENGLISH	2,121,512	21%
ENGLISH	7,823,174	79%
TOTAL RECORDS	9,944,686	100%

Appendix C

Citation Analysis

IEEE Transactions on Aerospace and Electronic Systems

Total 114 references 0 non-Eng. ref. 0% non-Eng. ref.

The Aeronautical Journal

Total 6 references 7 non-Eng. ref. 9.2 % non-Eng. ref.

Biotechnology and Bioengineering

Total 247 references 2 non-Eng. ref. 0.8% non-Eng. ref.

IEEE Transactions on Circuits and Systems

Total 216 references 2 non-Eng. ref. 0.9% non-Eng. ref.

Oil & Gas Journal

Total 38 references 0 non-Eng. ref. 0% non-Eng. ref.

Earthquake Engineering

Total 121 references 6 non-Eng. ref. 5.0% non-Eng. ref.

Journal of Chemical Technology and Biotechnology

Total 161 references 0 non-Eng. ref. 0% non-Eng. ref.

IEEE Transactions on Computers

Total 200 references 0 non-Eng. ref. 0% non-Eng. ref.

IEEE Transactions on Nuclear Science

Total 69 references 0 non-Eng. ref. 0% non-Eng. ref.

Journal of Materials Science

Total 362 references 29 non-Eng. ref. 8.0% non-Eng. ref.

Chemical Engineering

Total 17 references 0 non-Eng. ref. 0% non-Eng. ref.

Journal of Dynamic Systems Measurement and Control

Total 294 references 0 non-Eng. ref. 0% non-Eng. ref.

Total
1915 reference
46 non-Eng. ref.
2.4% non-Eng. ref.